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Special and General Theories of Relativity vs. Absolute Theory of Relativity, Parameterized Special Theory of Relativity, and NonInertial MultiRelativity

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Abstract

The comparison between Einstein's Theory of Relativity and the relativity theories proposed by Smarandache hinges on fundamental postulates regarding the speed of light, the nature of space and time, and the validity of classical versus relativistic velocity addition.

Keywords: Einstein's Theory of Relativity; Einstein's Special Theory of Relativity.

1 | Introduction

Smarandache's theories are presented as generalizations or alternatives that address perceived inconsistencies and paradoxes in Einstein's Special Theory of Relativity (STR).

Here is a detailed comparison of the key concepts:

1.1 | Comparison Table of Core Postulates

Feature	Einstein's Special Theory of Relativity (STR)	Smarandache's Absolute Theory of Relativity (ATR)	Smarandache's Parameterized STR (PSTR)
Space and Time	**Relative** space and **Relative** time (Minkowski's SpaceTime).	**Absolute** space and **Absolute** time.	$\tau = \frac{\Delta t'}{\Delta t}$ is an **open parameter**. PSTR does not assume the nature of space/time.
Speed Limit Postulate	Speed of light (**c**) is the **ultimate speed barrier**.	**No ultimate speed barrier** in the universe. Speeds up to infinity are theoretically possible.	Allows for an arbitrary ultimate velocity **K** (≥ 0) which can be smaller or greater than c.

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Velocity Addition	**Relativistic Addition of Velocities**: $v_1 \oplus_c v_2 = \frac{v_1 + v_2}{1 + \frac{v_1 \cdot v_2}{c^2}}$	**Vectorial Addition** (Classical Newtonian): $x^2 = v^2 + w^2 + 2vw\cos(\theta)$. This formula allows for superluminal speeds.	Generalized formula based on the parameter τ. The speed is $x^2 = v^2 + c^2\tau^2$ (for the light clock case).
Time Dilation/Length Contraction	**Time Dilation** and **Length Contraction** occur and are governed by the Lorentz factor $\gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}$.	**No Time Dilation** and **No Length Contraction**. The Lorentz factor is discarded (equal to 1).	The parameter τ determines the result, encompassing possibilities from STR to ATR and even "opposite time dilation" ($\Delta t > \Delta t'$).

1.2 | Absolute Theory of Relativity (ATR)

ATR is Smarandache's direct counterproposal to STR, based on the hypothesis that there is no speed limit in the universe.

- Refutation of STR: ATR posits that in the thought experiment with light clocks, the time intervals are the same for both observers (astronaut and earth observer), while the speeds are different. This is the "opposite of what Einstein did".
- Vectorial Addition: In the case where the particle's movement and the rocket's movement are orthogonal, the speed of the photon as seen by the earth observer is given by the Pythagorean sum (vectorial magnitude): $x = \sqrt{v^2 + c^2}$. Since this result is always greater than c (x > c), it demonstrates superluminal speeds are possible.
- Discarding Paradoxes: Because ATR removes time dilation and length contraction, it also discards many well-known relativistic paradoxes, such as the Twin Paradox and the Ehrenfest Paradox.

1.3 | Parameterized Special Theory of Relativity (PSTR)

PSTR is proposed as a meta-theory that generalizes both STR and ATR. It studies the general case of the light clock experiment without making initial assumptions about the ultimate speed or the nature of space/time.

- **The Parameter (τ):** The theory is defined by the parameter $\tau = \frac{\Delta t'}{\Delta t}$ ($\tau \in (0, +\infty)$), which is the ratio of the elapsed time measured in the moving frame ($\Delta t'$) to the time measured in the stationary frame (Δt).
- **STR and ATR as Subsets:**
  - **STR:** Occurs when the parameter is the Lorentz factor inverse: $\tau = \sqrt{1 - \frac{v^2}{c^2}}$.
  - **ATR:** Occurs when $\tau = 1$, representing absolute time ($\Delta t' = \Delta t$).
- **Additional Relativities:** PSTR allows for five or more possible relativities depending on the value of τ, including cases where time dilation is increased or decreased relative to STR, or even where the stationary observer measures a *shorter* time interval ($\Delta t' < \Delta t$).

- **Generalized STR (STR_K):** Smarandache also generalized the relativistic formulas (like the Lorentz factor and energy) to an arbitrary ultimate speed *K*, replacing *c* with *K*.

  $PSTR$ can be extended to $PSTR_K$ in a space S_K .

1.4 | NonInertial MultiRelativity

NonInertial MultiRelativity is presented as a **most general framework** for reference frames undergoing non-constant acceleration and non-linear motion.

- **Scope:** This concept extends the analysis from constant velocities (STR/ATR/PSTR) and constant acceleration to multiple reference frames (up to F_n) all moving on **arbitrary 3D-curves** with **non-constant accelerations**.
- **Objective:** The work outlines a set of open research problems to determine how physical quantities (trajectory, speed, acceleration, time) transform and are measured across these complex, non-inertial systems.

The **NonInertial MultiRelativity (NIMR)** concept proposed by F. Smarandache is the most generalized framework in his relativity theories, extending the analysis from constant motion (STR/ATR/PSTR) to complex, accelerating, multi-frame scenarios.

Since the concept primarily defines a research program rather than a single, complete theory with closed-form transformation equations, the information available is focused on the **ideas, scope, and open problems** it introduces.

Here is a breakdown of the key elements, formulas, and ideas associated with NonInertial MultiRelativity.

1.5 | Core Idea and Scope

Generalization of Frames

The central idea of NIMR is to move beyond the limitations of Special Relativity, which deals exclusively with Inertial Frames (constant velocity, zero acceleration), and even General Relativity, which often focuses on gravity as a curvature of spacetime, or frames under constant acceleration (like a uniformly accelerating rocket).

NIMR proposes to study a system composed of:

- Multiple Reference Frames ($F_1, F_2, ..., F_n$): A chain of reference frames.
- Arbitrary 3D-Curves ($C_1, C_2, ..., C_n$): Each frame follows a non-linear path.
- Non-Constant Accelerations ($a_1(t), a_2(t), ..., a_n(t)$): The acceleration of each frame changes over time.

The Problem Statement

The primary goal is to determine the transformation equations for physical quantities (position, velocity, time, acceleration) when relating the measurements made in one complex, non-inertial frame (F_i) to those made in the next frame (F_{i+1}), and ultimately to a supposed fixed frame (F_0).

1.6 | Theoretical Formulas and Transformations

Unlike STR or ATR, NIMR does not provide a single, universal set of closed-form transformation equations. Instead, it proposes a study that integrates concepts from classical mechanics and the generalized Parameterized STR ($PSTR_K$).

A. General MultiRelativistic System Structure

The relationship between any two consecutive frames, F_i and F_{i+1}, must account for the full classical mechanics transformation while incorporating a relativistic correction, possibly derived from PSTR.

Classical Non-Inertial Transformation (Simplified Basis):

For a position vector r observed from a stationary frame S and a non-inertial frame S' that is rotating and accelerating, the relationship for acceleration is complex. Smarandache's framework suggests extending this relativistic regime.

The classical acceleration transformation is:

$$\mathbf{a}_S = \mathbf{a}_{S'} + \mathbf{a}_{\text{transl}} + 2\boldsymbol{\omega} \times \mathbf{v}_{S'} + \dot{\boldsymbol{\omega}} \times \mathbf{r}_{S'} + \boldsymbol{\omega} \times (\boldsymbol{\omega} \times \mathbf{r}_{S'})$$

Where the terms are:

- $\mathbf{a}_{S'}$: Acceleration in the moving frame.
- $\mathbf{a}_{\text{transl}}$: Translational acceleration of S'
- $2\boldsymbol{\omega} \times \mathbf{v}_{S'}$: Coriolis Acceleration
- $\dot{\boldsymbol{\omega}} \times \mathbf{r}_{S'}$: Euler (Transverse) Acceleration (due to non-constant rotation $\dot{\boldsymbol{\omega}}$).
- $\boldsymbol{\omega} \times (\boldsymbol{\omega} \times \mathbf{r}_{S'})$: Centripetal Acceleration

B. Integration with Parameterized $STR(\text{PSTR}_K)$

The relativistic nature of NIMR comes from applying a generalized transformation (like a generalized Lorentz factor γK) to the time and distance measurements between two non-inertial frames.

If we let $\tau_{i,i+1}$ be the time ratio parameter relating F_i and F_{i+1}, this ratio is no longer constant, but a function of time, acceleration, and position: $\tau_{i,i+1}(t, a, r)$.

The general PSTR time dilation formula is: $\Delta t_{i+1} = \dfrac{\Delta t_i}{\tau_{i,i+1}}$.

In NIMR, the challenge is to derive $\tau_{i,i+1}$ from the complex, time-dependent kinematics.

C. Formulas from ATR/PSTR (Contextual)

While not inherently NIMR formulas, the following are the generalized templates that NIMR aims to connect via its non-inertial analysis:

Quantity	Generalized STR in SK (PSTR with K)	Absolute Theory of Relativity (ATR)
Lorentz/Relativistic Factor	$\gamma_K = \frac{1}{\sqrt{1-\frac{v^2}{K^2}}}$	$\gamma = 1$ (Discarded)
Relativistic Velocity Addition	$\mathbf{v}_1 \oplus_K \mathbf{v}_2 = \frac{\mathbf{v}_1 + \mathbf{v}_2}{1+\frac{\mathbf{v}_1 \cdot \mathbf{v}_2}{K^2}}$	$v_1 \oplus v_2 = v_1 + v_2$ (Classical)
Total Energy	$E = \gamma_K m_0 K^2$	$E = \frac{1}{2} m_0 v^2$ (Newtonian/Classical)

NIMR must ultimately determine how the kinematics in the general non-inertial setting influence v and K in these formulas, making them time- and curve-dependent.

1.7 | Applications and Research Directions

NIMR is less about providing a definitive physical model and more about identifying new research problems in extreme physics and cosmology:

A. Generalizing Relativistic Phenomena

- Time Dilation and Contraction in Non-Linear Motion: How do the parameters τ and K vary for a particle moving on a spiral or a helix with changing angular and translational acceleration?
- Doppler Shift in Complex Motion: Analyze the Doppler effect for light emitted between non-inertial frames moving on arbitrary 3D curves. This has applications in deep space communications and satellite dynamics.

B. Multi-Frame Cosmological Modeling

- Chained Systems: Modeling a complex system where a planet orbits a sun (F1 relative to F2), which in turn orbits a galactic center (F2 relative to F3), which is part of a moving cluster (F3 relative to F4), and so on. NIMR aims to transform observations across all these arbitrarily accelerating and curved frames.
- Testing Absolute Space/Time: The multi-frame, non-inertial setting is a way to try to differentiate between an absolute (ATR-like) framework and a purely relative (STR-like) one under the most complex motions possible.

C. Connection to Other Generalized Theories

The principles of non-constant acceleration and arbitrary curves are fundamentally about non-Euclidean geometry and non-linear dynamics.

- Geometrization of Transformations: The arbitrary 3D curves Ci suggest that the underlying spacetime geometry used to model these transformations must be non-Euclidean (potentially a generalized Riemannian Geometry) and dependent on the frames' acceleration history.

The work of Smarandache on MultiRelativity frames the problem as a required next step in physics—moving beyond the simplicity of inertial frames to fully encompass the complexity of the non-inertial world.

1.8 | Neutrosophic Logic (NL)

Classical logic, like Boolean logic, operates on a binary principle: a statement is either True or False. Fuzzy logic introduces degrees of truth between 0 and 1. Neutrosophic Logic generalizes this further by introducing three main components:

- **T (Truth):** The degree to which an assertion is true.
- **I (Indeterminacy):** The degree of uncertainty, paradox, or contradiction associated with the assertion.
- **F (Falsehood):** The degree to which the assertion is false.

These three components, T, I, and F, are independent and may sum to a value greater than 1 (or less than 1), unlike in Intuitionistic Fuzzy Sets where the degrees of membership and non-membership must sum to 1.

Connection to Relativity and PSTR

The concept of **Indeterminacy (I)** is key to the philosophical link with the **Parameterized Special Theory of Relativity (PSTR)**:

- **Challenging the Axioms:** Just as Neutrosophic Logic challenges the fundamental axiom of binary truth, PSTR challenges the fundamental axioms of STR (such as the constancy and ultimate speed of light, and the relativity of space/time).
- **A Space for the 'Neutral/Indeterminate':** PSTR introduces the parameter, which creates a continuum of possibilities that include STR, ATR, and other intermediate or new Relativities. This space of "neither-STR-nor-ATR" is analogous to the **Indeterminacy** component in Neutrosophic Logic.
- **Neutrosophy:** This is the philosophical current that underlies Neutrosophic Logic. It studies the origin, nature, and scope of neutralities, as well as their interactions with ideas of truth and falsehood. This search for neutrality between extremes mirrors the effort in PSTR to find a neutral, parameterized framework that includes both absolute and relative physics.

The work you are asking about, ATR and PSTR, can be viewed as an application of the broader **Neutrosophic** philosophy to the domain of theoretical physics.

1.9 | Paradoxes and Open Questions on Special and General Relativity

Smarandache has formulated a broader class of paradoxes, often expressed in the form:

Paradox: Let A be some attribute (e.g., possible, present, perfect, etc.). If all is A, then the non-A must also be A. For example, "All is possible, the impossible too," and "Nothing is perfect, not even the perfect" [1-8].

In the book New Relativistic Paradoxes and Open Questions, Smarandache presents several inconsistencies and dilemmas in the Special and General Theories of Relativity.

Key Paradoxes and Inconsistencies

- Refuting the Speed of Light Postulate: Proposes the hypothesis (since 1972) that there is no speed barrier in the universe and superluminal phenomena do not violate causality or require infinite energy.
- Criticism of Time Dilation and Length Contraction:
    - The length contraction is independent of time, which is questioned as being non-normal for an object in flight.
    - The "miraculous" breaking and restoration of rigid bodies that shrink during flight.

- Contradictions regarding the symmetry/asymmetry of time dilation in different examples.

- Relativity of Simultaneity: Proposes that the relativity of simultaneity may be just an appearance.
- Issues with General Relativity (GTR):
  - Dilemmas for the Weak and Strong Equivalence Principles (e.g., that constant acceleration is not equivalent to heterogeneous gravity).
  - Questions the concepts of gravitational lensing and redshift/blueshift, suggesting they may be due to the medium's composition (e.g., "Medium Lensing").
  - Proposes that the Frame Dragging effect is just the classical vortex.

Ethical Approval

This article does not contain any studies with human participants or animals performed by any of the authors.

Consent for Publication

This article does not contain any studies with human participants or animals performed by any of the authors. Each author contributed to and agreed with this publication.

Declaration of Competing Interest

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